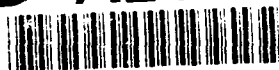


QUARTERLY PROGRESS REPORT

AD-A249 814



SPONSORED BY:

DEFENSE ADVANCED RESEARCH PROJECTS AGENCY
DEFENSE SCIENCES OFFICE

RF VACUUM MICROELECTRONICS
ARPA ORDER NO. 8162

ISSUED BY DARPA/CMO UNDER CONTRACT No. MDA972-91-C-0032

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1. AGENCY USE ONLY (Leave Blank)		2. REPORT DATE 23 April 1992		3. REPORT TYPE AND DATES COVERED Quarterly 1 Jan 92 to 31 March 92
4. TITLE AND SUBTITLE RF Vacuum Microelectronics Quarterly Progress Report Number 2			5. FUNDING NUMBERS C MDA972-91-C-0032	
6. AUTHOR(S) Dr. Alan Palevsky				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Raytheon Company Research Division 131 Spring Street Lexington, MA 02172			8. PERFORMING ORGANIZATION REPORT NUMBER RAY/RD/S-4752	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) DARPA 3701 North Fairfax Drive Arlington, VA 22203-1714			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release Distribution Unlimited			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 Words) The status of research and development on field emission array cathodes for RF vacuum microelectronics is presented. The dc emission characteristics have improved. Designs for high frequency circuits are complete and are being fabricated.				
14. SUBJECT TERMS Field Emission, Vacuum Tubes, Cathodes			15. NUMBERS OF PAGES 5	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT Unclassified		18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified		19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified
20. LIMITATION OF ABSTRACT				

IV FISCAL STATUS

CONTRACT NO: MDA972-91-C-0032
 CONTR. TITLE: RF VACUUM MICROELECTRONICS
 CONTRACTOR: RAYTHEON CO., RESEARCH DIV.

DATE PREPARED:
 REPORT PERIOD:

04-Mar-92
 01/27/92-02/23/92

FUNDS AND MANHOUR EXPENDITURE REPORT

CONTRACT VALUE:	\$1,095,328
CURRENT FUNDING (sell):	\$762,000
NEG. FEE RATE:	0.0%

	CONTRACT VALUE	REPORTING MO. EXPEN- DITURES	CUMULATIVE EXPEND. TO DATE	% \$ VALUE	COST TO COMPLETE ESTIMATE	LATEST COST ESTIMATE	PREVIOUS COST ESTIMATE
A	B	C	D	E	F	G	H
TOTAL PRIME LABOR HOURS	7,467	292	1,420		8,047	7,467	
TOTAL PRIME LABOR	\$203,891	\$8,581	\$42,772		\$161,119	\$203,891	0
LABOR OVERHEAD	\$362,926	\$14,929	\$75,792		\$287,134	\$362,926	0
TOTAL LABOR & OVERHEAD	\$566,817	\$23,510	\$118,564		\$448,253	\$566,817	0
MATERIALS	\$220,841	\$5,128	\$6,880		\$213,961	\$220,841	0
ODC	\$830	\$76	\$428		\$402	\$830	0
MWR	\$135,944	\$4,302	\$7,934		\$128,010	\$135,944	0
PRODUCT COST	\$924,432	\$33,016	\$133,806		\$790,626	\$924,432	0
G & A	\$148,407	\$5,255	\$22,046		\$126,361	\$148,407	0
COM	\$22,489	(\$1,349)	\$2,870		\$19,619	\$22,489	0
TOTAL COST LEVEL	\$1,095,328	\$36,922	\$158,722		\$936,606	\$1,095,328	0
FEE	\$0	\$0	\$0		\$0	\$0	0
TOTAL CONTRACT PRICE	\$1,095,328	\$36,922	\$158,722	14.49%	\$936,606	\$1,095,328	0
OUTSTANDING COMMIT		\$113,472	\$113,472				
TOTAL COMMIT & EXPEND.	\$1,095,328	\$150,394	\$272,194	24.85%	\$936,606	\$1,095,328	0

EXPENDITURES THIS QUARTER: \$101,907

TOTAL EXPENDITURES TO DATE: \$158,722

PROJECTED EXPENDITURES:
 01/92 - 03/92: \$160,500
 04/92 - 06/92: \$175,000
 07/92 - 09/92: \$198,400
 10/92 - 12/92: \$215,100

TOTAL FY92 EXPENDITURES: \$692,622

1) IS CURRENT FUNDING SUFFICIENT (Y/N): YES
 2) WHAT IS FY93'S FUNDING REQUIREMENT?: \$1,095,328
 3) IS ALL DATA CROSS REFERENCED?: YES

Accession for

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Unannounced ☐

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QUARTERLY PROGRESS REPORT NO. 2

1/2/92 - 3/31/92

Sponsored By: Dr. Bertram Hui
DARPA/DSO
3701 N. Fairfax Drive
Arlington, VA 22203
Tel: (703) 696-2239

Monitored By:

Contractor: Raytheon Company
Research Division
131 Spring Street
Lexington, MA 02173

Effective Date of Contract: September 18, 1991

Contract Expiration Date: March 15, 1993

Contract Amount - Basic : \$1,095,328
- Options: \$ 640,090

Principal Investigator: Dr. Alan Palevsky
Tel: (617) 860-3036
FAX: (617) 860-3195

Title of Work: Research on RF Vacuum Microelectronics

Y
I. EXECUTIVE SUMMARY

Raytheon

VHF micro-triode (cylindrical) design complete
VHF micro-triode machined parts and masks ordered
Initial design for planar triode complete
Flanges for planar triode ordered
Series resistor process development started
Achieved 10uA/tip emission

Cornell

Fabricated 400 element arrays with dimpled grid structure
Performed initial test to verify a.c. (10kHz) and d.c. emission from arrays. 100 volt turn on voltage.
Fabricated package to demonstrate Rf modulation of the structures.

II. MILESTONES STATUS

	Completion Date	
	Original	Actual
1. Tip Field Emitter		
1.1 Process enhancement	2/93	
1.2 Leakage current suppression	7/92	4/92
1.3 Series resistor development	9/92	
1.4 Alternative Emitter materials	2/93	
2. Wing Field Emitter		
2.1 Process development	4/92	
2.2 Electrical tests	6/92	
3. DC/Low Frequency Test		
3.1 Improve bakeout and turn on proc.	12/91	12/91
3.2 Life tests	2/93	
4. High Frequency Design		
4.1 VHF micro-triode (cylindrical) design/fab	5/92	
4.2 Planar micro-triode design/fab	5/92	
5. High Frequency Test		
5.1 Test VHF micro-triode	8/92	
5.2 Test planar micro-triode	8/92	

III. TECHNICAL PROGRESS

Raytheon

- 1.1 A set of wafers were processed with only a small number of single tip as opposed to large arrays. This let us examine variations among single tips as opposed to ensemble averages. We found the variations in gate voltage for a given current to be as great as thirty volts. This indicates that probably only a small number of tips are providing all the current in the large arrays.
- 1.3 It also shows the need for a good ballast resistor to limit the current from the lower gate voltage tips. A process to add a series resistance to each tip is under development.
- 1.4 Studies of alternative emitter materials have started. 1000 angstroms of hafnium was put down on moly tips but electrical tests show no improvement. We are now looking at metal carbides which are refractory and are supposed to have a low work function. A novel deposition scheme will be used for these materials.

4.1-2

The design of the both high frequencies triodes was completed. All the ceramic and metal parts for the VHF micro-triode were ordered. The masks for fabrication of the emitter for the triode were layed out and ordered. Processing of wafers for this triode should start at the end of April. The masks for the planar triode are currently in layout. The high frequency, bakable to 450 degrees centigrade, vacuum coaxial lines and feedthru's needed for this circuit are waiting for vendor pricing. The base flanges on which the high frequency lines attach to is already on order. All the test equipment needed to test these two types of triodes will be procured before chips are available and therefore should not be a gating item.

The new evaporator (purchased with internal funds) should be ready to use in the July time frame. This should reduce our processing time from six weeks to four weeks.

IV. FISCAL STATUS

V. PROBLEM AREAS

No electrical performance has been obtained from the wing (circular edge emitters. We will probably stop all contract work on this style of emitter next quarter.

VI. VISITS AND TECHNICAL PRESENTATIONS

Both Raytheon and Cornell presented at the first Semi-Annual review with all the other contractors.